

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of:

Digital Audio Broadcasting Systems)	
And Their Impact on the Terrestrial)	MB Docket No. 99-325
Radio Broadcast System)	

To the Commission:

**Comments Concerning the
Proposal to Increase the Power of IBOC DAB by
10 dB**

Introduction

In response to the Federal Communications Commissions, "COMMENT SOUGHT ON JOINT PARTIES REQUEST FOR FM DIGITAL POWER INCREASE AND ASSOCIATED TECHNICAL STUDIES", a group of 18 broadcasters that operate over 1200 commercial and noncommercial educational (NCE) FM radio stations throughout

the United States and the 4 largest manufacturers of broadcast transmission equipment along with iBiquity Digital Corporation ("iBiquity") which concurrently filed technical reports. The group is requesting that the Commission to increase the maximum permissible digital operating power from its current levels of 1 percent, -20 dBc, to 10 percent, -10 dBc. The Joint Parties request that the Commissions authorize voluntary increased digital operation power for FM stations up to the proposed maximum limit¹.

History

"The Commission often has recognized the importance of our free, over-the-air radio broadcast service, with its unrivaled accessibility and unique ability to provide local news, information and public service programs. Although this vital communications service continues to grow and prosper, it faces significant technical limitations² and competitive challenges. Opportunities for new and improved FM service are limited by spectrum congestion in most major and mid-sized radio markets.³ The Commission has established low power FM ("LPFM") service, but acknowledged that there is difficulty finding sufficient spectrum for this service^{4, 5} In addition, the Commission emphasized localism as a "touchstone value" of the terrestrial radio broadcast service."⁶

The Commission drafted a "Tentative Selection Criteria for a DAB System"⁷. The Commission sought to determine which DAB model and/or system would best promote

¹ Public Notice DA 08-2340 Released: October 23, 2008

² Citation needed.

³ See, e.g., 1998 Biennial Regulatory Review--Streamlining of Radio Technical Rules in Parts 73 and 74 of the Commission's Rules, Notice of Proposed Rule Making and Order in MM Docket No. 98-93, 13 FCC Rcd 14849, 14857 (1998).

⁴ Creation of a Low Power Radio Service, Notice of Proposed Rule Making in MM Docket No. 99-25, 14 FCC Rcd 2471, 2489 (1999) ("LPFM Notice"). The Commission proposed the LPFM service to "address unmet needs for community-oriented radio broadcasting, foster opportunities for new radio broadcast ownership, and promote additional diversity in radio voices and program services." Id. at 2471.

⁵ See: FCC – 07-217 Adopted: December 18, 2007 Released: March 05, 2008 – filed comments

⁶ Docket No. 90-357 NPRM. 7 FCC Red at 7793 (Separate Statement of Commissioner Ervin S. Duggan).

⁷ MM Docket No. 99-325 Notice of Proposed Rule Making - Adopted: November 1, 1999 - Released: November 1, 1999

our above stated public policy objectives. In reaching this fundamental determination, the Commission propose to apply the following evaluative criteria: (1) enhanced audio fidelity; (2) robustness to interference and other signal impairments; (3) compatibility with existing analog service; (4) spectrum efficiency; (5) flexibility, (6) auxiliary capacity; (7) extensibility; (8) accommodation for existing broadcasters; (9) coverage; and (10) implementation costs/affordability of equipment. The order of these proposed criteria is not intended to imply a hierarchy among them.⁸

As the Commission has stated, “IBOC systems are designed to allow the simultaneous broadcast of analog and digital signals in the AM and FM bands without disruption of existing analog service.”⁹ The Commission’s rules impose limits or ‘emission masks’ on the power of a station’s signal inside and outside its assigned channel.¹⁰ Together with minimum spacing requirements, emission masks prevent interference by limiting a station’s signal strength relative to other, nearby stations operating on co- and adjacent channels. These limits are based on analog signal transmissions centered on their assigned channels.

In the ‘hybrid’ operational mode, IBOC systems transmit lower power digital signal “sidebands” that are positioned on either side of the host analog signal. The digital signal waveforms are designed to conform to the current emission masks (as *established by NSRC*).¹¹ The digital signals were designed to “interleaved: station A’s upper digital sideband would be located between 1st adjacent channel station B’s lower and upper digital sidebands, and adjoining station B’s carrier frequency. In addition, the presence of digital sidebands would reduce the separation between the host analog signal and 2nd and 3rd adjacent channels digital signals. IBOC system proponents

⁸ Id. 8 at ¶ 20.

⁹ Id. 8 at ¶ 7.

¹⁰ See 47 C.F.R. §§ 73.44, 73.317.

¹¹ The IBOC FM 70-kHz digital sidebands would be positioned in the upper and lower 1st adjacent channels between +/-129 kHz and +/-199 kHz from the carrier frequency.

believe that digital signal processing techniques would have permitted the transmission of a digital "pair" of each analog signal in the AM and FM bands, without disrupting existing analog service."¹²

¹² Id. 8 at ¶ 7.

Discussion

W220DQ

In the previous paragraph, it becomes clear that the Commission and iBiquity's proposed IBOC solution never address the protection of the first adjacent channels. Neither 47 C.F.R. §§ 73.317 nor the NSRC documents adequately protect adjacent channel interference.

In September 2006, I conducted a study between WREH¹³ and WXEL-FM¹⁴. WREH is a class C1 directional with an effective radiated power of 92 kilo-watts¹⁵ operating on channel 213 (90.5 MHz) serving Cypress Quarters, Florida. WXEL-FM is a class C1 directional with an effective radiated power of 38 kilo-watts operating on channel 214 (90.7 MHz) serving West Palm Beach, Florida.

¹³ WREH – BLED-20041116ACR – owned by Reach Communications, Inc.

¹⁴ WXEL – BLED-20030417ABF – owned by Barry Telecommunications, Inc. WXEL is the local National Public Radio affiliate for West Palm Beach, Florida.

¹⁵ WREH has a Jampro JCPD-5/3 (15) DA which is a circularly polarized antenna. It has an effective radiated power of 92 kilo-watts in the vertical pole and 100 kilo-watts in the horizontal pole.

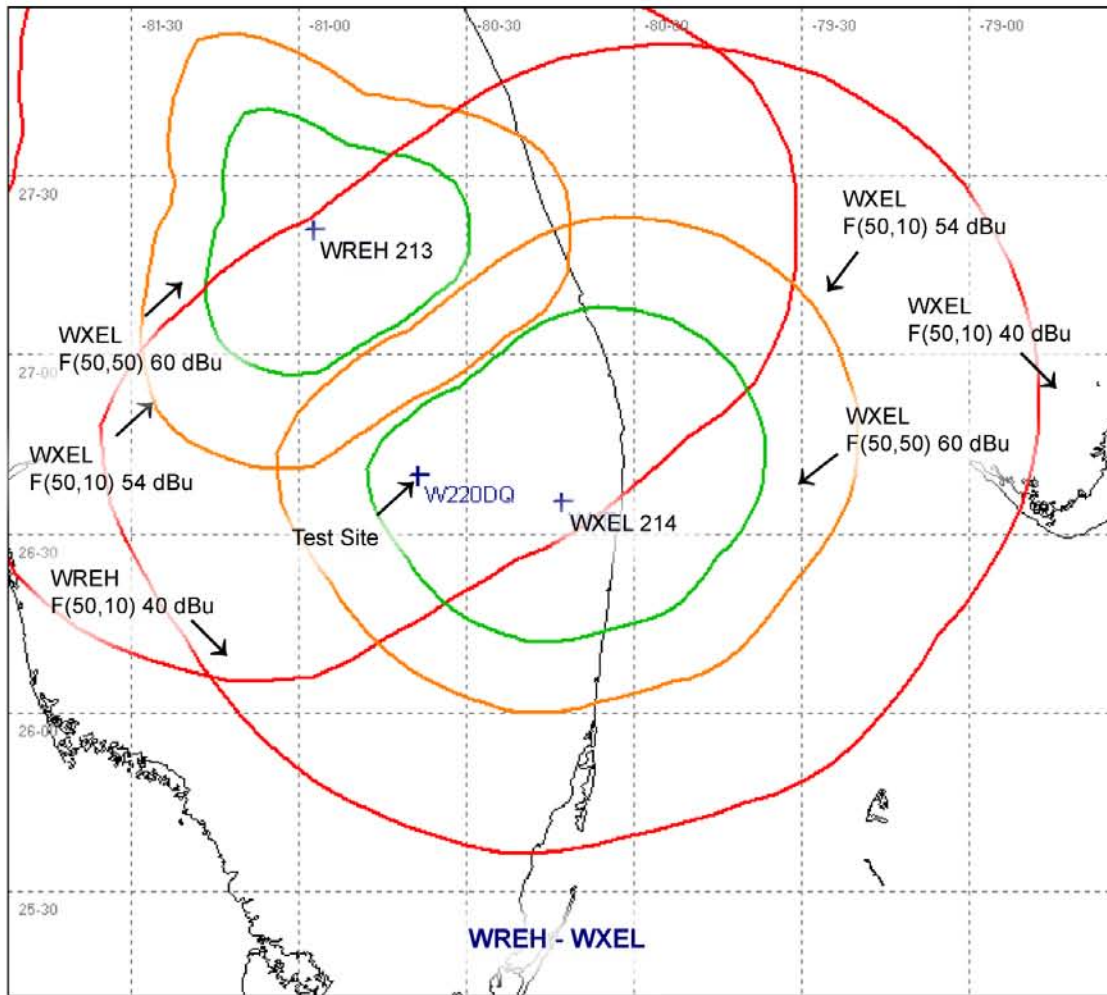


Figure 1 – Contours WREH - WXEL

Figure 1 above shows the relationship between WREH, WXEL and the test site. WREH and WXEL are first adjacent with respects to each other. This is the situation that is cited in the previous paragraphs above¹⁶ and not covered by the neither FCC nor iBiquity back in 1999 and 2002. WXEL is approximately 43.8 km - 27.4 miles at a bearing 100.4 degrees from the test site. WREH is 82.1 km – 51.3 miles at a bearing of 335.7 degrees from the test site. WREH was marginally listenable at the test site when WXEL's HD IBOC component is off.

¹⁶ Id. 8 at ¶ 7.

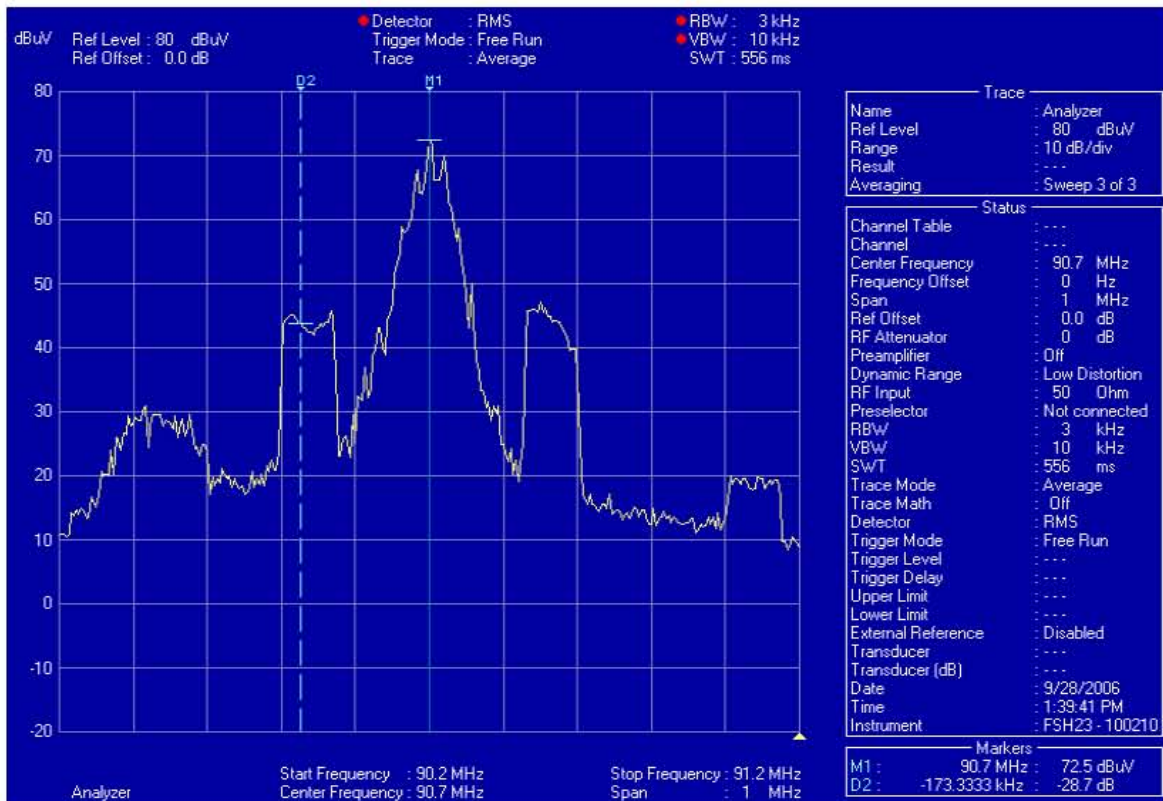


Figure 2

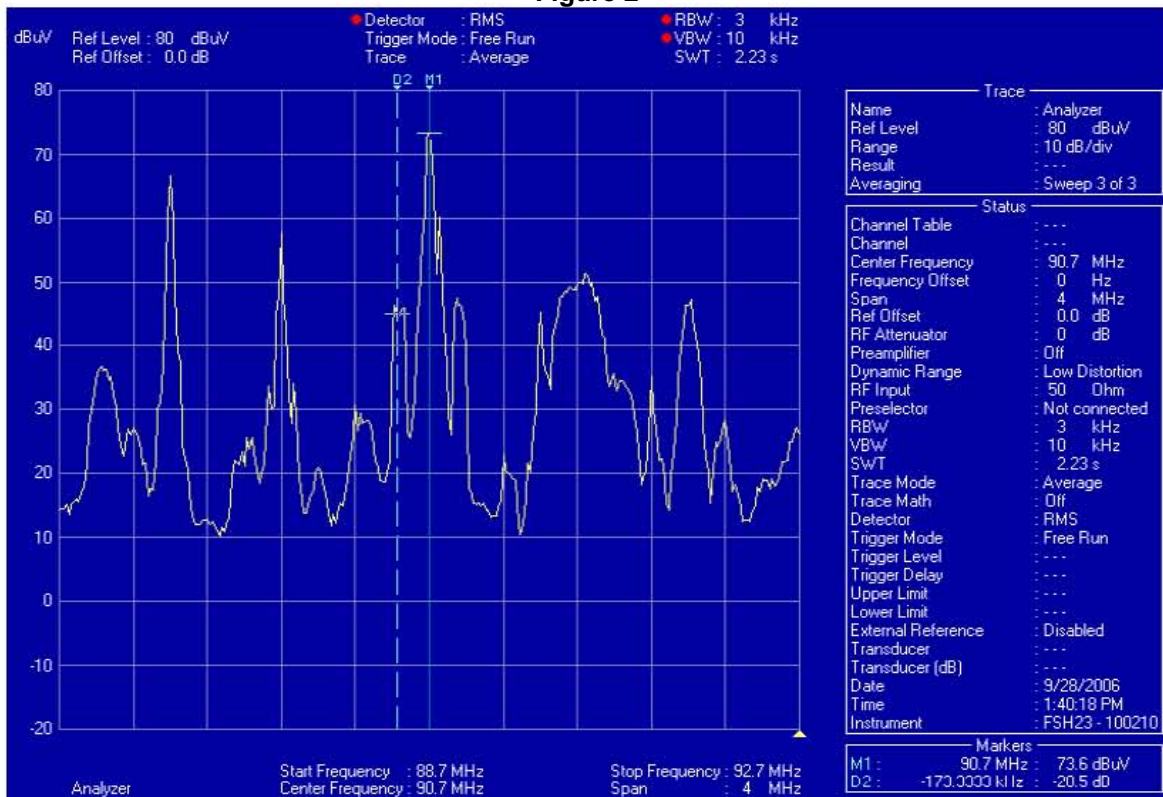


Figure 3

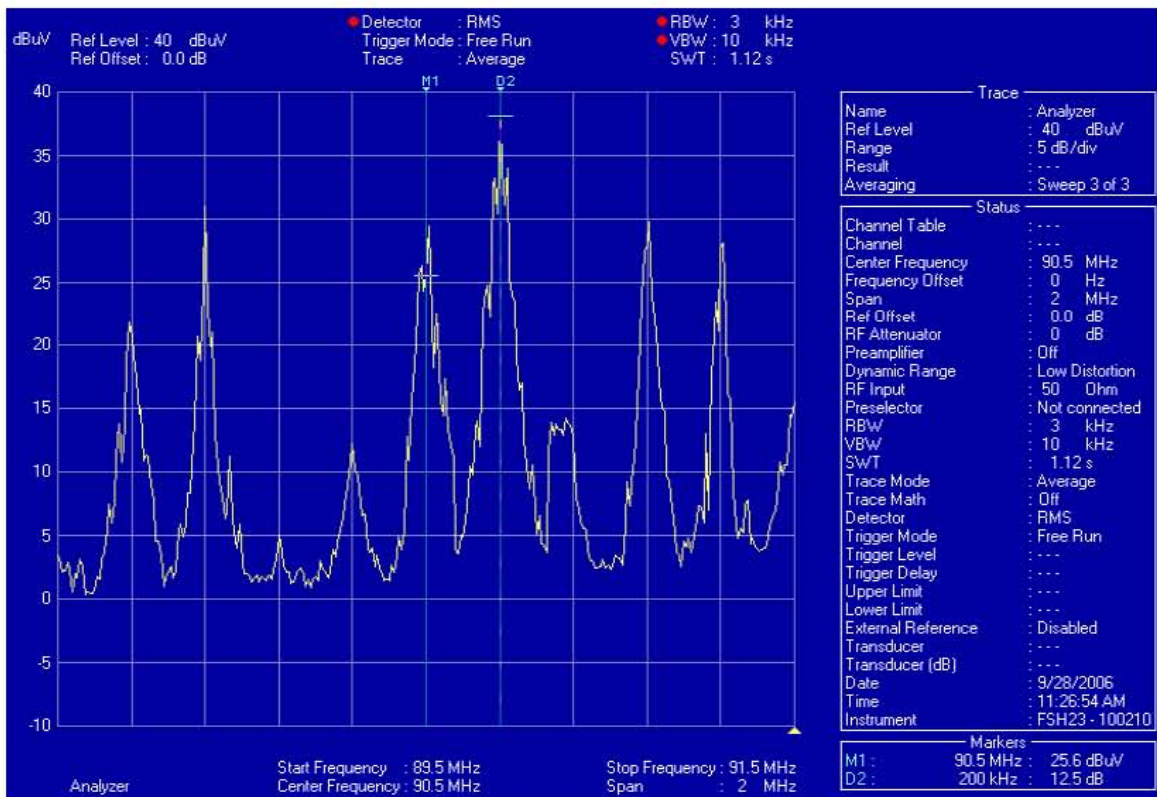


Figure 4

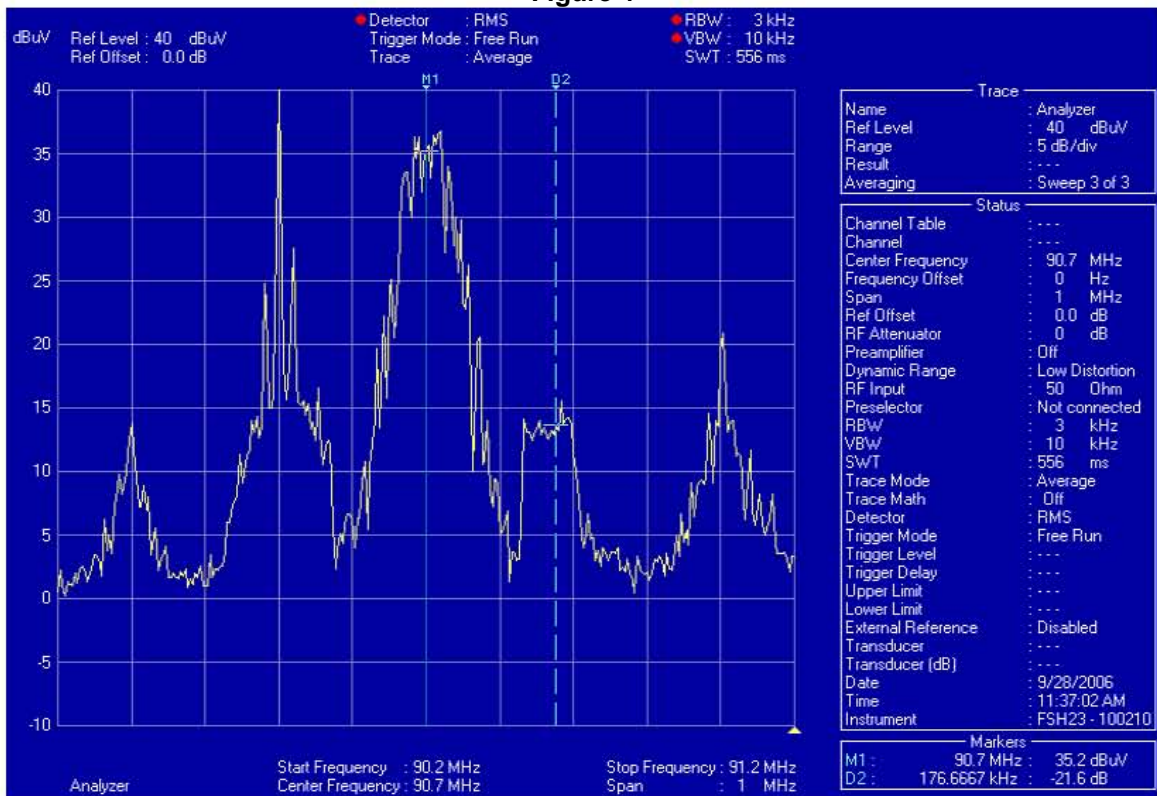


Figure 5

All the Figures above were taken using a Rohde & Schwarz FSH3 spectrum analyzer connected to a Scala HDCA 10 mounted to a tower approximately 30 meter above ground level during September of 2006. In figures 2 and 3, the signal at 90.7 MHz is WXEL 214 analog signal and its companion IBOC signal. Notice that at the time theses sweeps were captured, WXEL's IBOC signal was at -28.5 dBc and thus lower than normally allowed.

Figures 2 and 3 shows WXEL's signal as it would normally appear without WREH's signal. Figure 4 shows both signal on with modulation. Figure 5 shows both signal on with no modulation on WREH's carrier.

WREH's peak carrier with no modulation was determined to be 39.2 dbuv while WXEL's lower IBOC side band was determined to be at 13.4 dbuv. The D/U (desired to undesired signal ratio) was calculated to be 25.8 dbuv.

This signal was then fed into an Inovonics 631 FM rebroadcast receiver. An Inovonics 531 Modulation Monitor was then connected to the output of the receiver as well as directly to the transmission line. With a D/U at 25.8 dbuv an over all signal to noise ratio was observed to be 24 db in the analog domain. The signal to noise ratio on the subcarrier was observed to be 25 db. When the subcarrier was suppressed from the composite, the signal to noise dropped significantly to 45 db. When the IBOC component was removed the overall signal to noise dropped to 58 db. A Fan Fair FT1AP along with a Digital Radio Express – FM Extra receivers were also employed in this test. The results were similar.

This site is a translator site for Reach Communications. Thus the receivers composite output would normally be connected to a Crown transmitter. Since the Inovonics 631 receiver always supplies a wide band composite output, we connected the decoded analog outputs of the receiver to the transmitter. A Telewave TWPC1005-2 Dual filter along with a Telewave TPRC1005-2 Dual filter Pass Reject were placed in the

RF path in front of the receiver and tuned to maximize WREH (desired) and minimize the HD components of WXEL (undesired). With this situation an overall signal to noise ratio of 25 db was obtained. With the receiver in mono mode and set optimally and an overall signal to noise ratio of 41 db was obtained. Without WXEL's HD component (undesired) the overall signal to noise ratio dropped to 61 db in stereo mode.

As shown in the sweeps above, it was determined that the HD component contributed significantly to the degradation of the signal used for the translator as well as the signal that a listener could hear on the ground.

Similar measurements were taken at later dates with similar results.

National Public Radio Labs -

Digital Radio Coverage & Interference Analysis (DRCIA) Research Project Final Report on CPB Contract No. 10446

“NPR, through the Corporation for Public Broadcasting (CPB) - funded Digital Radio Coverage and Interference Analysis (DRCIA) project, *which* examined the coverage capabilities and impact of in-band on channel digital audio broadcasting (IBOC DAB) in the United States.

Since this digital transmission system may be added to existing broadcast stations in the FM band, CPB created the DRCIA project for three primary goals: to determine the coverage capabilities of (1) legacy analog FM service and (2) IBOC DAB service, and (3) evaluate the impact of the digital transmission system on reception of analog FM service, assuming all stations are operating in hybrid mode. CPB commissioned NPR Labs (which enlisted experts from other organizations on a subcontract basis) to conduct an extensive study of these issues. This study was recommended by the Digital Consultancy in 2005, was carefully designed by CPB and NPR to answer these questions, and was launched in late 2006.

As described in the full report, available at www.nprlabs.org, NPR Labs, led by project director and Senior Technologist John Kean, performed detailed receiver performance testing that was validated by carefully selected field tests. The analog receiver performance data was used to develop maps predicting, for the first time, actual coverage available to public radio listeners. Drawing on tests of digital receivers, NPR Labs spent a year painstakingly developing the first

field-corroborated coverage prediction algorithm for IBOC DAB. This yielded more firsts: maps of public radio station coverage assuming all stations are operating in hybrid mode, for both their digital and analog services."¹⁷

While NPR's Executive Summary and the Full Report highlighted both positive and negative aspects to an increase in power to the IBOC signal, I have chosen to place an emphasis on the later.

NPR found:

1: "Unqualified 10% IBOC transmission power is predicted to cause substantial interference to analog reception of a significant number of first- and second-adjacent channel stations."¹⁸

2: From a theoretical model, at 1 percent IBOC transmission levels, "Mobile analog FM population would be reduced an average of 14% for the sample stations due to interference from IBOC DAB. This affects most stations in varying degrees in outlying portions of their mobile analog service area."¹⁹

3: At 10 percent IBOC transmission levels, "Analog FM indoor and portable covered population totals are reduced by 22% and 6%, respectively. Interference would affect some stations severely in portions of their analog indoor service area: 27% could lose one-third or more of their covered population and 16% could lose more than half of their population."²⁰

4: "Station impacts from IBOC DAB to analog FM vary widely from station to station, primarily due to the fact that the IBOC DAB digital sidebands are actually co-channel to neighboring stations on first-adjacent channels; the FCC's first-adjacent allocation rules for analog FM cannot adequately protect against some close-spaced conditions."²¹

¹⁷: NATIONAL PUBLIC RADIO, Final Report to the Corporation for Public Broadcasting, Digital Radio Coverage & Interference Analysis (DRCIA) Research Project, EXECUTIVE SUMMARY - July 09, 2008"

¹⁸ "NATIONAL PUBLIC RADIO, Final Report to the Corporation for Public Broadcasting, Digital Radio Coverage & Interference Analysis (DRCIA) Research Project, EXECUTIVE SUMMARY - July 09, 2008" pages 4 - 6.

¹⁹ Id. 19

²⁰ Id. 19

²¹ Id. 19

5: “Stations on “non-commercial” channels (88.1-91.9 MHz) and “commercial” FM channels (92.1-107.9 MHz) would receive similar amounts of interference to their analog operations from IBOC DAB at 10% power. This is notable since it was expected that commercial channels have more conservative protection standards.”²²

6: “Initial projected system-wide estimates of the costs of deploying a combination of optimization strategies for indoor digital coverage parity could approach a doubling of transmission investments.”²³

7: “Input interference to existing analog FM translators, should all stations convert to IBOC DAB, is expected to affect approximately 5% of all translators.”²⁴

8: “Current field evidence, including listener reports, of interference to analog reception from IBOC DAB at 1% power is minimal. This may suggest that interference is less noticeable than predicted, however, due to the noiselike nature of IBOC-to-analog interference, which lacks the audible clues of typical analog-to-analog interference, it may be difficult for field listeners to identify an interfering IBOC signal and report their impaired reception.”²⁵

In fact, as NPR states, “interference is less noticeable than predicted, however, due to the noiselike nature of IBOC-to-analog interference”, is correct. An uninformed listener will tend to accept and tolerate white or pink noise as normal, especially in these types of comparison test. However, the noise is a very undesirable artifact that degrades the listen-ability of the station especially when it is compared to another station without the artifact.

NPR tried to analyze and quantized the noise issue²⁶. While the subject of psychoacoustics is interesting, I find that using a small group of lay persons to establish that a signal to noise ratio of 30 to 40 db of pink noise behind desirable

²² Id. 19

²³ Id. 19

²⁴ Id. 19

²⁵ Id. 19

²⁶ NATIONAL PUBLIC RADIO - Report to the Corporation for Public Broadcasting -Digital Radio Coverage & Interference Analysis - (DRCIA) Research Project - Final Report Deliverable 6.2.2 –CPB Account No. 10446 - Reporting Date: May 16, 2008 – Section 7

programming content is an acceptable level of impairment, is an unacceptable method as to determining a new industry standard. Further, it has been long established by the Commission²⁷ and the industry that a standard minimum quality of signal should be maintained at broadcast sites. An overall 60 db signal to noise ratio should be obtainable for broadcast FM stations and has been a widely accepted defacto standard. Sometime in the past, the Commission required FM broadcast stations to meet this standard. I consider the method and results of the evaluation of the noise issues to be a flawed within the NPR study.

The NPR study also states that:

“Input interference to existing analog FM translators, should all stations convert to IBOC DAB, is expected to affect approximately 5% of all translators.”²⁸ This statement is apparently based on model and statistical analysis.²⁹ NPR only analyzed 26 translators and determined that two cases met their criteria for interference based on their interference Table 1 in their study. Only five of their cases were based on co-channel interference. Only two of the cases were first adjacent interference. They did not identify the other cases. How they arrive at the 5 percent is unclear. I see them already at 26 percent based on the Full Reports findings.

Table 1 in their report shows that they have determined a first adjacent D/U ratio of 8 db is adequate for reception. W220DQ situation cited above, which is a real world situation, indicates different results. The table also was based on 1

²⁷ 47 C.F.R. §§ 73.310, 47 C.F.R. §§ 73.319, 47 C.F.R. §§ 73.508

²⁸ Id. 19 page 5

²⁹ NATIONAL PUBLIC RADIO - Report to the Corporation for Public Broadcasting -Digital Radio Coverage & Interference Analysis - (DRCIA) Research Project - Final Report Deliverable 6.2.2 –CPB Account No. 10446 - Reporting Date: May 16, 2008 – Section 3.1.2

percent hybrid to analog interference and not 10 percent hybrid to analog interference.

iBiquity Digital Corporation -
Consumer Testing HD Radio System Testing at Increased Power Levels

“This study assessed the impact on consumers of increasing the digital power levels for iBiquity Digital Corporation’s FM HD Radio broadcast from -20dBc to -10dBc on the analog listening experience for consumers”.³⁰ “Results from the **subjective testing**³¹ indicated that: ...

5: Speech is the genre most likely to show differences between -10 and -20dBc.”³²

This test was purely subjective as they clearly state. No quantitative measurements were take at all relative to the noise being compared. By their own admission, they employed techniques to mask the noise and further established levels by one person’s individual ear. No equipment was used to measure levels. Item 5 above indicates by their own admission that there was a noticeable increase in noise.

³⁰ iBiquity Digital Corporation - Consumer Testing HD Radio System Testing at Increased Power Levels – Executive Summary - page 1.

³¹ Emphasis added.

³² Id. 32

**FM HD Radio System Performance
At
Elevated Carrier Levels
December 2007**

This report only compares the HD IBOC signals at the two different power levels from a qualitative perspective. Again no significant quantitative data was reported, nor was interference to analog source discussed.

Conclusion

It becomes clear that the Commission and iBiquity's proposed IBOC solution never address the protection of adjacent channels. Neither 47 C.F.R. §§ 73.317 nor the NSRC documents adequately protect adjacent channel interference. 47 C.F.R. §§ 73.317 was created at a time to protect analog to analog momentary interference. It was never meant to be applied to any kind of digital interference.

In the case of W220DQ cited above, a D/U ratio of 25.8 db is not adequate on top of an analog carrier when the digital noise is 13.4 dbuv. In addition, the method of measurement did not reveal all the energy within the area of concern, because of filtering characteristics of a spectrum analyzer verse the unseen noise.

Currently and in the past, the Commission has relied on the iBiquity to provide technical data justifying its position. iBiquity's interest may not always be those of the public. With the current "White Space" discussions, the FCC Office of Engineering and Technology has taken a lead role in the testing and analysis of data with respects to the use of future "White Space" devices. Perhaps OET needs to analyze iBiquity's request and the whole IBOC issues. There seems to be no one of the technical side representing the public in the iBiquity IBOC issues. At the very least, independent testing needs to be performed.

iBiquity has formed a consortium of large broadcasters and equipment manufactures who have already bought into this project. As cited above, the iBiquity IBOC system by its very nature was designed to displace the current first adjacents in a new system. By it's nature, the small broadcaster is in the process of being displaced and eliminated by the cost of capital improvements and the lack of spectrum need to operate.

The Commission has supported the smaller broadcaster in the past. In an earlier Public Notice³³, the Commission sought comments on the Expansion of the FM Band by reallocating the current television channels 5 and 6. Such a reallocation could solve this and a number of other problems the Commission is trying to deal with. The results of the recent NCE October 2007 filing window would definitely indicate a demand for expansion. The figure below shows the area of the spectrum discussed.

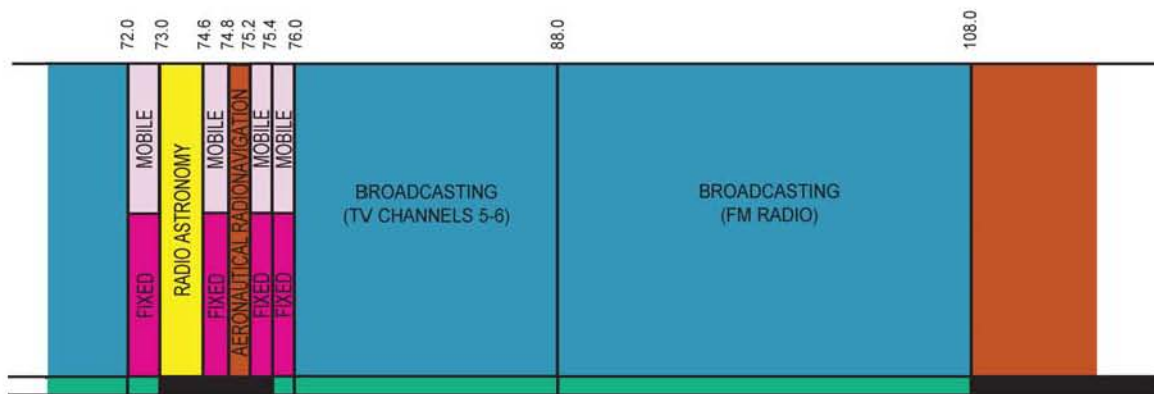


Figure 7³⁴

The creation of a digital only band could happen and broadcasters interested in digital radio could migrate to that spectrum. A newly created digital band would not have the noise and interference issues that currently exist in a mix band.

On the other hand, there is a rather simple solution to iBiquity's concerns. It is call an outdoor antenna. Created by Dr. Hidetsugu Yagi, the Yagi antenna has been found to perform quite well in these situations. Chairman Martin, if you would like, I can arrange to have one installed at your home. Perhaps, OET could use it to test iBiquity's concerns. While iBiquity and other wish to better penetrate concrete buildings, I represent clients who wish to better penetrate bank vaults with their conventional FM signals. Does anyone want to sign the NPRM with my clients for this?

³³ FCC – 07-217 Adopted: December 18, 2007 Released: March 05, 2008

³⁴ <http://www.ntia.doc.gov/osmhome/allochrt.pdf>

When the Commission proposed a digital radio system, they had a number of goals that they wanted the industry to meet.

- (1) enhanced audio fidelity;
- (2) robustness to interference and other signal impairments;
- (3) compatibility with existing analog service;
- (4) spectrum efficiency;
- (5) flexibility,
- (6) auxiliary capacity;
- (7) extensibility;
- (8) accommodation for existing broadcasters;
- (9) coverage; and
- (10) implementation costs/affordability of equipment.³⁵

Perhaps this is the moment to analyze how iBiquity's IBOC system has performed towards meeting these goals.

It is important that the Commission preserve the small broadcaster. Larger broadcasters have taken away the localism of radio as they have sought to maximize profits at the expense of the community. The smaller broadcaster is a thread with in the community. Their elimination will be the loss of the viewpoints of millions in this nation.

³⁵ Id. 9.

I urge the Commission to move cautiously on iBiquity's request to increase HD IBOC power. Again, at the very least, independent testing needs to be performed. iBiquity and its partners have yet to show the need for the power increase nor show how they plan to minimize interference. Solutions to interference needs to be addressed before more power is added to the band.

This is the time for the Commission to provide direction and leadership.

Charles (Ched) Keiler – CPBE

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³⁶ Membership through Reach Communications, Inc.